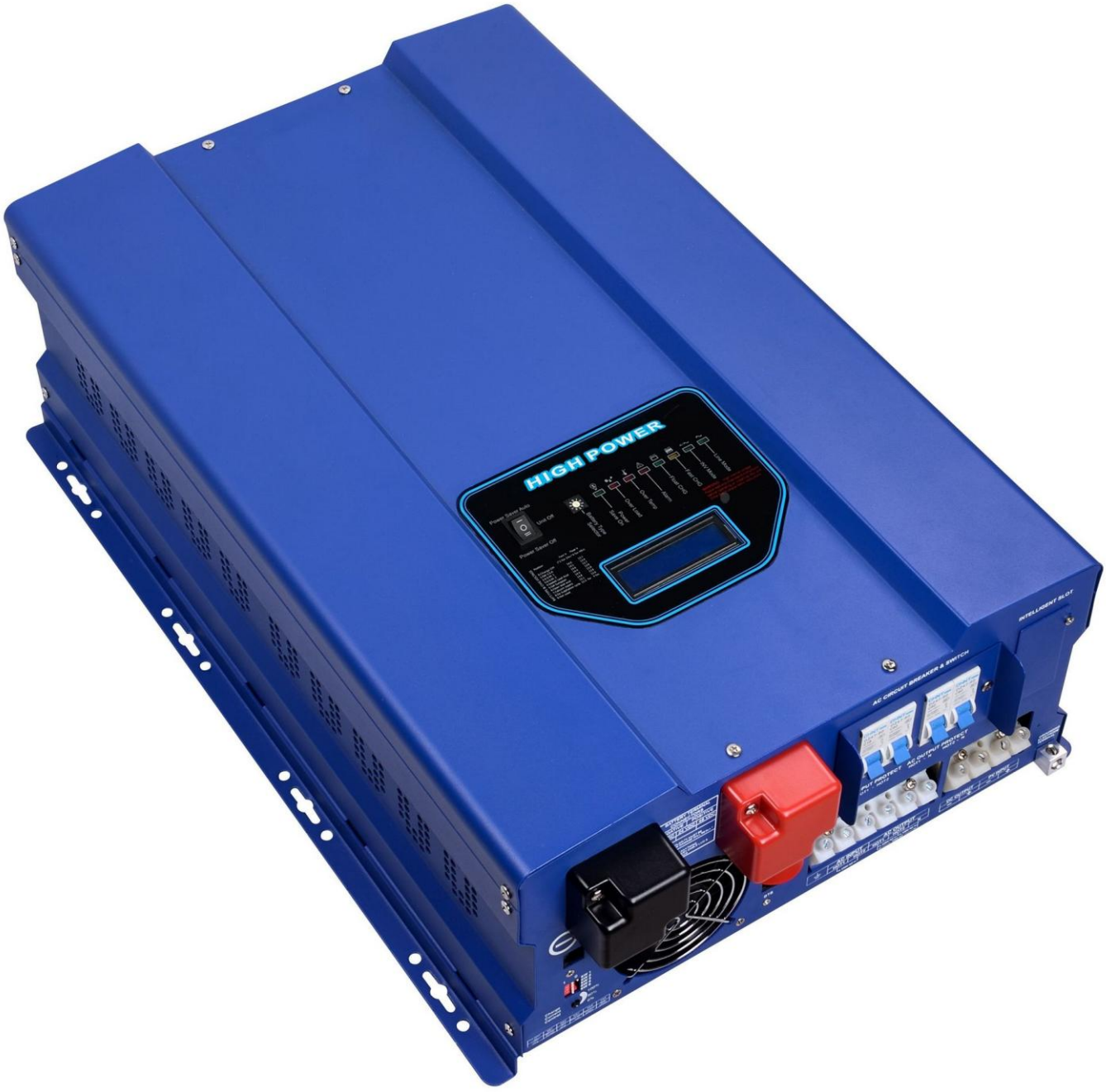
HP Series
Pure Sine Wave Inverter/Charger
User's Manual

Version 1.0



Date: JULY, 2013

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1. Important Safety Information

⚠ **WARNING!** Before using the Inverter, you need to read and save the safety instructions.

1-1. General Safety Precautions

1-1-1.Do not expose the Inverter to rain, snow, spray, bilge or dust. To reduce risk of hazard, do not cover or obstruct the ventilation openings. Do not install the Inverter in a zero-clearance compartment. Overheating may result. Allow at least 30CM(11.81 inches) of clearance around the inverter for air flow. Make sure that the air can circulate freely around the unit. A minimum air flow of 300CFM is required.
1-1-2. To avoid a risk of fire and electronic shock. Make sure that existing wiring is in good electrical condition; and that wire size is not undersized. Do not operate the Inverter with damaged or substandard wiring.
1-1-3. This equipment contains components which can produce arcs or sparks. To prevent fire or explosion do not install in compartments containing batteries or flammable materials or in locations which require ignition protected equipment. This includes any space containing gasoline-powered machinery, fuel tanks, or joints, fittings, or other connection between components of the fuel system.
See Warranty for instructions on obtaining service.
1-1-4. Do not disassemble the Inverter/Charger. It contains no userserviceable parts. Attempting to service the Inverter/Charger yourself may result in a risk of electrical shock or fire. Internal capacitors remain charged after all power is disconnected.
1-1-5. To reduce the risk of electrical shock, disconnect both AC and DC power from the Inverter/Charger before attempting any maintenance or cleaning. Turning off controls will not reduce this risk
CAUTION: Equipment damage
The output side of the inverter's AC wiring should at no time be connected to public power or a generator. This condition is far worse than a short circuit. If the unit survives this condition, it will shut down until corrections are made.
Installation should ensure that the inverter's AC output is, at no time, connected to its AC input.
Warning: Limitations On Use
SPECIFICALLY, PLEASE NOTE THAT THE APC SERIES INVERTER/CHARGER SHOULD NOT BE USED IN CONNECTION WITH LIFE SUPPORT SYSTEMS OR OTHER MEDICAL EQUIPMENT OR DEVICES.

1-2. Precautions When Working with Batteries

1-2-1. If battery acid contacts skin or clothing, wash immediately with soap and water. If acid enters eye, immediately flood eye with running cold water for at least 20 minutes and get medical attention immediately.
1-2-2. Never smoke or allow a spark or flame in vicinity of battery or engine.
1-2-3. Do not drop a metal tool on the battery. The resulting spark or short-circuit on the battery of other electrical part may cause an explosion.
1-2-4. Remove personal metal items such as rings, bracelets, necklaces, and watches when working with a lead-acid battery. A lead-acid battery produces a short-circuit current high enough to weld a ring or the like to metal, causing a severe burn.
1-2-5. To reduce the risk of injury, charge only rechargeable batteries such as deep-cycle lead acid, lead antimony, lead calcium gel cell, absorbed mat, NiCad/NiFe or Lithium battery. Other types of batteries may burst, causing personal injury and damage.

2. Introduction

2-1. General Information

Thank you for purchasing the HP Series Inverter/Charger.
HP Series Pure Sine Wave Inverter is a combination of an inverter, battery charger, auto generator starter and AC auto-transfer switch into one complete system with a peak conversion efficiency of 88%.
It is packed with unique features and it is one of the most advanced inverter/chargers in the market today.
It features power factor corrected, sophisticated multi-stage charging and pure sine wave output with unprecedentedly high surge capability to meet demanding power needs of inductive loads without endangering the equipment.

When utility AC power cuts off(or falls out of acceptable range), the transfer relay is de-energized and the load is automatically transferred to the Inverter output. Once the qualified AC utility is restored, the relay is energized and the load is automatically reconnected to AC utility.
The HP Series Inverter is equipped with a powerful charger of up to120Amps (depending on model).
The overload capacity is 300% of continuous output for up to 20 seconds to reliably support tools and equipment longer

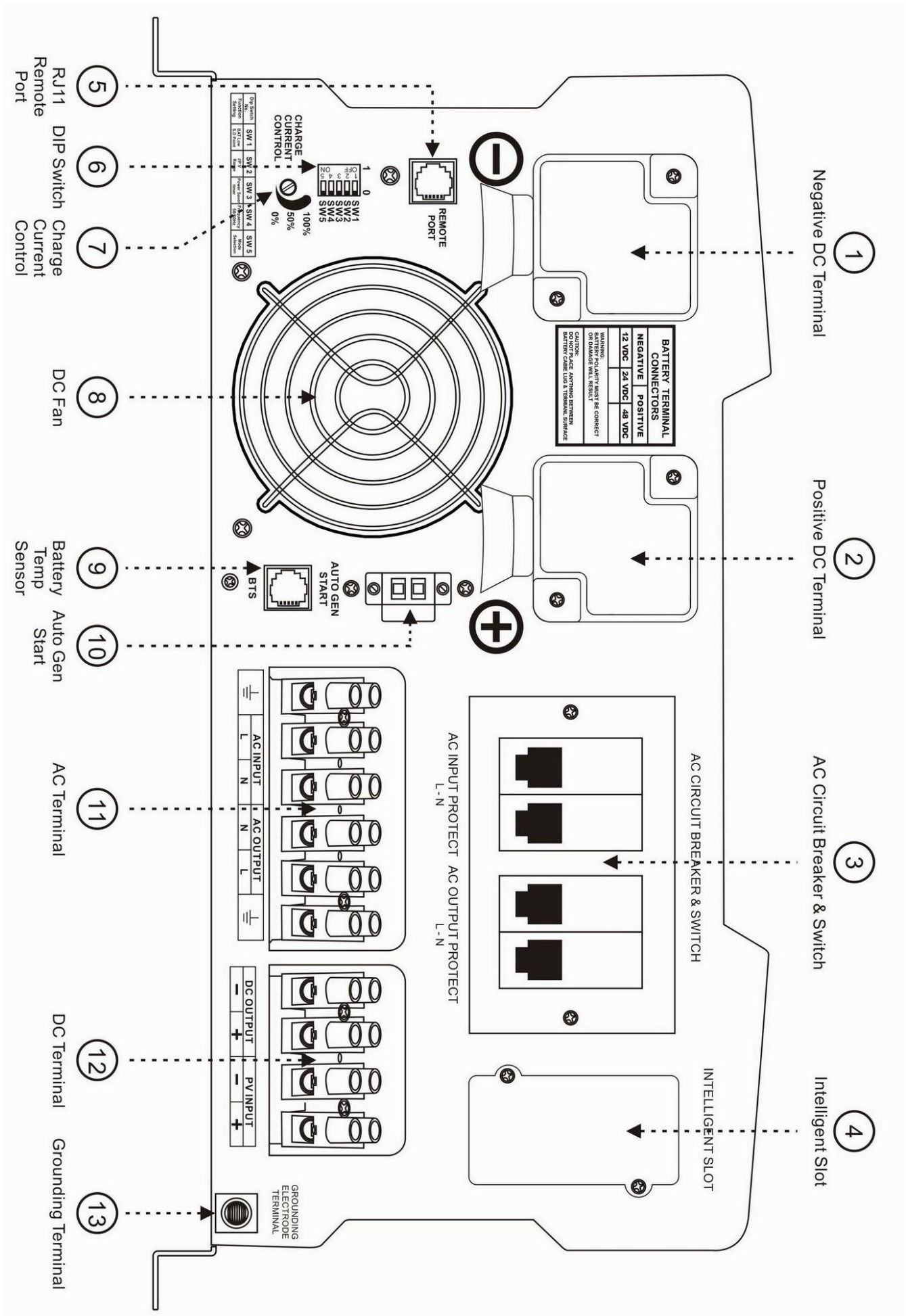
Another important feature is that the inverter can be easily customized to Battery priority via a DIP switch, this helps to extract maximum power from battery in renewable energy systems.
Thus, the HP Series Pure Sine Wave Inverter is suitable for Renewable energy system, Utility, RV, Marin and Emergency appliances.

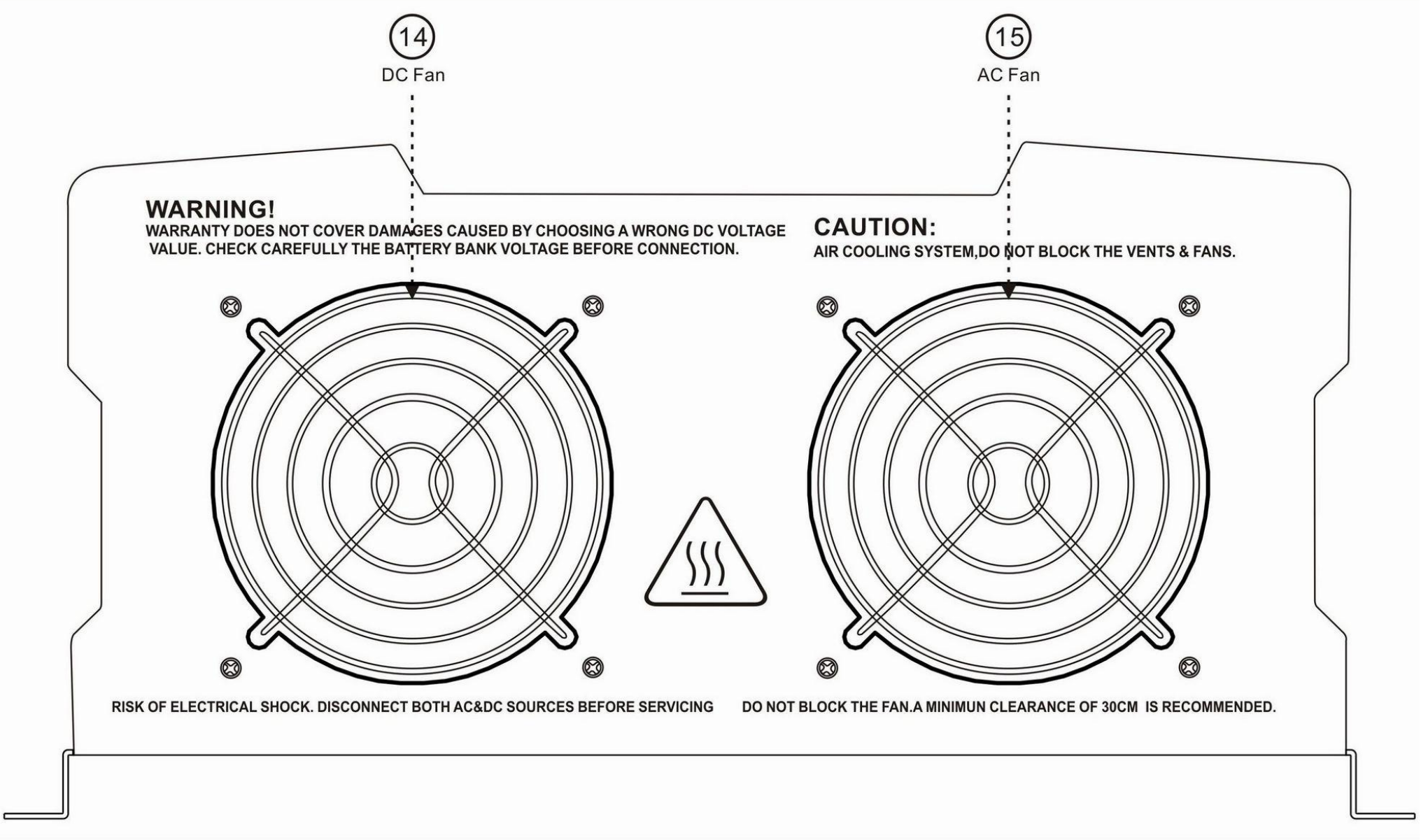
To get the most out of the power inverter, it must be installed, used and maintained properly. Please read the instructions in this manual before installing and operating.

2-2. Application

Power tools–circular saws, drills, grinders, sanders, buffers, weed and hedge trimmers, air compressors.
Office equipment – computers, printers, monitors, facsimile machines, scanners.
Household items – vacuum cleaners, fans, fluorescent and incandescent lights, shavers, sewing machines.
Kitchen appliances – coffee makers, blenders, ice markers, toasters.
Industrial equipment – metal halide lamp, high – pressure sodium lamp.
Home entertainment electronics – television, VCRs, video games, stereos, musical instruments, satellite equipment.

2.3 Mechanical Drawing




14
DC Fan
15
AC Fan
WARNING!
WARRANTY DOES NOT COVER DAMAGES CAUSED BY CHOOSING A WRONG DC VOLTAGE VALUE. CHECK CAREFULLY THE BATTERY BANK VOLTAGE BEFORE CONNECTION.
CAUTION:
AIR COOLING SYSTEM,DO NOT BLOCK THE VENTS & FANS.
RISK OF ELECTRICAL SHOCK. DISCONNECT BOTH AC&DC SOURCES BEFORE SERVICING
DO NOT BLOCK THE FAN.A MINIMUN CLEARANCE OF 30CM IS RECOMMENDED.

2-4. Features

High overload ability up to 300% of rated power(20 sec)
Low quiescent current, low power 'Power Saving Mode' to conserve energy
Automatic Generator Starting
Battery Temperature Sensing for increased charging precision
4-step intelligent battery charging, PFC(Power Factor Correction) for charger
8 pre set battery type selector plus de-sulphation for totally flat batteries
Powerful charge rate up to 120Amp, selectable from 0%-100%
10 ms typical transfer time between battery and AC, guarantees power continuity
Smart remote control with optional LCD display
15s delay before transfer when AC resumes, extra protection for loads when used with generator
Allows start up and through power with depleted batteries
Multiple controlled cooling fan
Extensive protections against various harsh situations
Low battery recover function and Battery priority mode, dedicated for renewable energy systems

2.5 Electrical Performance

2.5.1 Invert

Topology
The HP inverter/charger is built according to the following topology.
Invert: Full Bridge Topology.
Charge: Isolated Boost Topology
Because of high efficiency Mosfets and 16bit, 4.9MHZ microprocessor and heavy transformers, it outputs PURE SINE WAVE AC with an average THD of 8% (min 3%, max 10% under full linear load) depending of load connected and battery voltage.
The peak efficiency of HP series is 88%.

Overload Capacity
The HP series inverters have different overload capacities, making it ideal to handle demanding loads.
1 For 110%<Load<125%(±10%), no audible alarm in 14 minutes, beeps 0.5s every 1s in the 15th minute, and Fault(Turn off) after the 15th minute.
2 For 125%<Load<150%(±10%), beeps 0.5s every 1s and Fault(Turn off) after the 1 minute.
3 For 300%≧Load>150%(±10%), beeps 0.5s every 1s and Fault(Turn off) after 20s.

Caution:
After the inverter is switched on, it takes a finite time for it to self diagnose and get ready to deliver full power. Hence, always switch on the load(s) after a few seconds of switching on the inverter. Avoid switching on the inverter with the load already switched on. This may prematurely trigger the overload protection. When a load is switched on, it may require initial higher power surge to start. Hence, if multiple loads are being powered, they should be switched on one by one so that the inverter is not overloaded by the higher starting surge if all the loads are switched on at once.

2.5.2 AC Charger

HP Series is equipped with an active PFC (Power Factor Corrected) multistage battery charger. The PFC feature is used to control the amount of power used to charge the batteries in order to obtain a power factor as close as possible to 1.

Unlike other inverters whose max charging current decreases according to the input AC voltage, HP series charger is able to output max current as long as input AC voltage is in the range of 164-243VAC(95-127VAC for 120V model), and AC freq is in the range of 48-54Hz(58-64Hz for 60Hz model).

The HP series inverter has a very rapid charge current available, and the max charge current can be adjusted from 0%-100% via a liner switch to the right of the battery type selector. This will be helpful if you are using our powerful charger on a small capacity battery bank.

Choosing “0” in the battery type selector will disable charging function.

There are 3 main stages:

Bulk Charging: This is the initial stage of charging. While Bulk Charging, the charger supplies the battery with controlled constant current. The charger will remain in Bulk charge until the Absorption charge voltage (determined by the Battery Type selection) is achieved.

Software timer will measure the time from A/C start until the battery charger reaches 0.3V below the boost voltage, then take this time asT0 and T0 ×10 = T1.

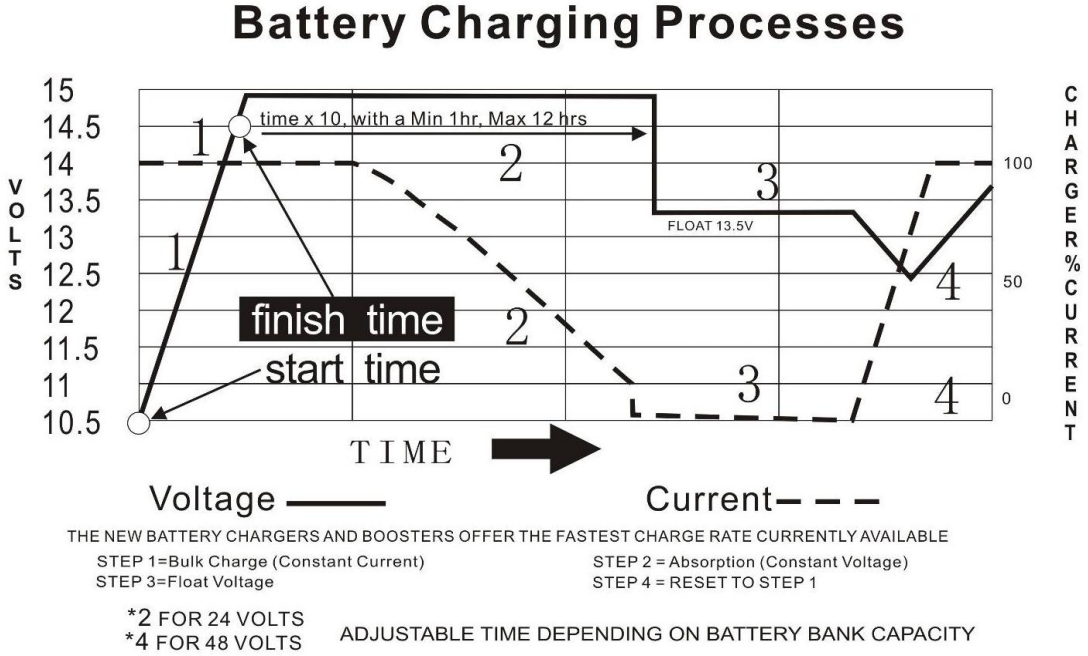
Absorb Charging: This is the second charging stage and begins after the absorb voltage has been reached. Absorb Charging provides the batteries with a constant voltage and reduces the DC charging current in order to maintain the absorb voltage setting.

In this period, the inverter will start a T1 timer; the charger will keep the boost voltage in Boost CV mode until the T1 timer has run out. Then drop the voltage down to the float voltage. The timer has a minimum time of 1 hour and a maximum time of 12 hours.

Float Charging: The third charging stage occurs at the end of the Absorb Charging time. While Float charging, the charge voltage is reduced to the float charge voltage (determined by the Battery Type selection*). In this stage, the batteries are kept fully charged and ready if needed by the inverter.

If the A/C is reconnected or the battery voltage drops below 12Vdc/24Vdc/48Vdc, the charger will reset the cycle above.

If the charge maintains the float state for 10 days, the charger will deliberately reset the cycle to protect the battery.



De-sulphation

The de-sulphation cycle on switch position 8 is marked in red because this is a very dangerous setting if you do not know what you are doing. Before ever attempting to use this cycle you must clearly understand what it does and when and how you would use it.

What causes sulphation? This can occur with infrequent use of the batteries, nor if the batteries have been left discharged so low that they will not accept a charge. This cycle is a very high voltage charge cycle designed to try to break down the sulphated crust that is preventing the plates from taking a charge and thus allow the plates to clean up and accept a charge once again.

Battery type selector			
Switch setting	Description	Boost / Vdc	Float / Vdc
0	Charger Off		
1	Gel USA	14.0	13.7
2	AGM 1	14.1	13.4
3	AGM 2	14.6	13.7
4	Sealed lead acid	14.4	13.6
5	Gel EURO	14.4	13.8
6	Open lead acid	14.8	13.3
7	Calcium	15.1	13.6
8	De sulphation	15.5 (4 Hours then Off)	
9	Not used		
12Vdc Mode (*2 for 24Vdc ; *4 for 48Vdc)			

Charging depleted batteries

The HP series inverter allows start up and through power with depleted batteries.

For 12VDC model, after the battery voltage goes below 10V, if the switch is still(and always) kept in "ON" position, the inverter is always connected with battery, and the battery voltage doesn't drop below 2V, the inverter will be able to charge the battery once qualified AC inputs.

Before the battery voltage going below 9VDC, the charging can activated when the switch is turned to "Off", then to "ON".

When the voltage goes below 9VDC, and you accidently turn the switch to OFF or disconnect the inverter from battery, the inverter will not be able to charge the battery once again, because the CPU lose memory during this process.

Start up without battery function can be customized upon request.

Charging current for each model

Model Watt	Battery Voltage	Charging Current	Model Watt	Battery Voltage	Charging Current
1KW	12 Vdc	35±5 Amp	2KW	12 Vdc	60±5 Amp
1KW	24 Vdc	20±5 Amp	2KW	24 Vdc	30±5 Amp
1KW	48 Vdc	10±5 Amp	2KW	48 Vdc	15±5 Amp
3KW	12 Vdc	80±5 Amp	4KW	12 Vdc	100±5 Amp
3KW	24 Vdc	45±5 Amp	4KW	24 Vdc	55±5 Amp
3KW	48 Vdc	25±5 Amp	4KW	48 Vdc	35±5 Amp
5KW	24 Vdc	65±5 Amp	6KW	24 Vdc	80±5 Amp
5KW	48 Vdc	40±5 Amp	6KW	48 Vdc	50±5 Amp
8KW	24 Vdc	100±5 Amp	10KW	48 Vdc	80±5 Amp
8KW	48 Vdc	65±5 Amp	12KW	48 Vdc	120±5 Amp

The charging capacity will go to peak in around 3 seconds, this may probably cause a generator to drop frequency, making inverter transfer to battery mode.

It is suggested to gradually put charging load on the generator by switching the charging switch from min to max, together with the 15s switch delay, our inverter gives the generator enough time to spin up.

Caution:

Pls turn the charge current control switch gently to avoid breakage due to over-turning.
To guarantee the best performance of AC charger when the AC input is from a generator, the standby generator should be at least 150% of higher capacity than the inverter

2.5.3 Transfer

While in the Standby Mode, the AC input is continually monitored. Whenever AC power falls below the VAC Trip voltage (154 VAC, default setting), the inverter automatically transfers back to the Invert Mode with minimum interruption to your appliances - as long as the inverter is turned on. The transfer from Standby mode to Inverter mode occurs in approximately 10 milliseconds. And it is the same time from Inverter mode to Standby mode.
Though it is not designed as a computer UPS system, this transfer time is usually fast enough to hold them up.
There is a 15-second delay from the time the inverter senses that continuously qualified AC is present at the input terminals to when the transfer is made. This delay is built in to provide time for a generator to spin-up to a stable voltage and avoid relay chattering. The inverter will not transfer to generator until it has locked onto the generator's output. This delay is also designed to avoid frequent switch when input utility is unstable.

2.5.4 Solar Charger

For HP series, solar chargeing modul is optional, and up to two pcs can be built in.

Listed below is the spec for solar charger

Table 1 Electrical Specifications **@ 25℃(77℉)**

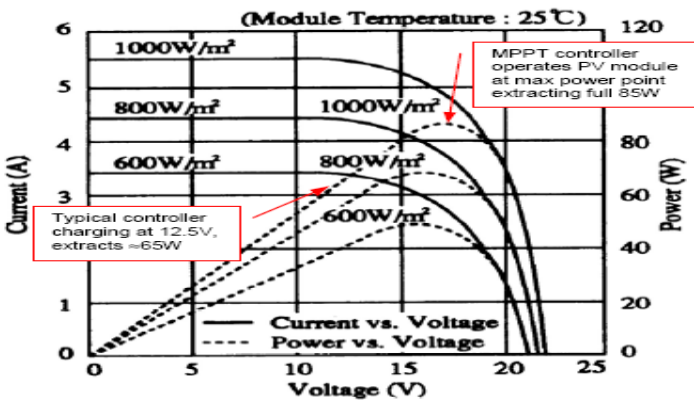
Rated Voltage	12Vdc	24Vdc	48Vdc
Rated Charge Current (Includes Load Current)	40/60Amp		40Amp
MAX DC Load Current	15Amp		
Input Voltage Range	15-30Vdc	30-55Vdc	60-100Vdc
Max. PV Open Circuit Array Voltage	35Vdc	60Vdc	105Vdc
Overload Protection (DC load)	2.0 * I(Rated)>5s； 1.5 * I(Rated) >20s 1.25 * I(Rated) Temperature Controlled		
Typical Idle Consumption	At idle < 10mA		
Bulk Charge	14.6Vdc	29.2Vdc	58.4Vdc
Floating Charge	13.4Vdc	26.8Vdc	53.6Vdc
Equalization Charge	14.0Vdc	28.0Vdc	58.0Vdc
Over Charge Disconnect	14.8Vdc	29.6Vdc	59.2Vdc
Over Charge Recovery	13.6Vdc	27.2Vdc	54.4Vdc

Over Discharge Disconnect	10.8Vdc	21.6Vdc	43.2Vdc
Over Discharge Reconnect	12.3Vdc	24.6Vdc	49.6Vdc
Temperature Compensation	-13.2mV/℃	-26.4mV/℃	-52.8mV/℃
Lead Acid Battery Settings	Adjustable		
NiCad Battery Settings	Adjustable		
Low Voltage Reconnect	12.0-14.0Vdc	24.0-28.0Vdc	48.0-56.0Vdc
Low Voltage Disconnect	10.5-12.5Vdc	21.0-25.0Vdc	42.0-50.0Vdc
Ambient Temperature	0-40℃ (Full load) 40-60℃ (De-rating)		
Altitude	Operating 5000m, Non-Operating 16000m		
Protection Class	IP21		
Battery Temperature Sensor①	BTS (Optional) Remote Battery Temperature Sensor for Increased Charging Precision		
Terminal Size (Fine/Single Wire)	#8 AWG		

NOTE:

① The optional battery temperature sensor automatically adjusts the charging process of the controller according to the type of battery that is selected by user through battery type selector. With the battery temperature sensor installed, the controller will increase or decrease the battery charging voltage depending on the temperature of the battery to optimize the charge to the battery and maintain optional performance of the battery.

Maximum Power Point Tracking (MPPT) Function



Maximum Power Point Tracking, frequently referred to as MPPT, is an electronic system that operates the Photovoltaic (PV) modules in a manner that allows the modules to produce all the power they are capable of.

The PV-seeker Charge controller is a microprocessor-based system designed to implement the MPPT.

And it can increase charge current up to 30% or more compared to traditional charge controllers (see figure 1).

Figure 1 Current, Power vs. Voltage Characteristics

The Charge controller built in is with 12/24V battery voltage auto detecting function.

For 12VDC inverter, the output voltage of solar charger will be accordingly 12VDC, and the qualified DC input volt range is 15v-30VDC.

For 24VDC inverter, the output voltage of solar charger will be accordingly 24VDC, and the qualified DC input volt range is 30V-55VDC.

For 48VDC inverter, the output voltage of solar charger will be accordingly 48VDC, and the qualified DC input volt range is 60v-110VDC.

If the voltage falls out of this range, the charger will not work properly. Special attention should be paid to this when configuring the solar array.

2.5.5 Power Saver

There are 2 different working statuses for HP inverter: “Power On” and “Power Off”.
When power switch is in “Unit Off” position, the inverter is powered off.
When power switch is turned to either of “Power Saver Auto” or “Power Saver Off”, the inverter is powered on.
Power saver function is to dedicated to conserve battery power when AC power is not or little required by the loads.
In this mode, the inverter pulses the AC output looking for an AC load (i.e., electrical appliance). Whenever an AC load (greater than 25 watts) is turned on, the inverter recognizes the need for power and automatically starts inverting and output goes to full voltage. When there is no load (or less than 25 watts) detected, the inverter automatically goes back into search mode to minimize energy consumption from the battery bank.
In “Power saver on” mode, the inverter will draw power mainly in sensing moments, thus the idle consumption is significantly reduced.
The inverter is factory defaulted to detect load for 250ms in every 3 seconds. This power sensing can be customized to “Unit off charging” via the SW3 on DIP switch.

Power saver on	Power saver off	Power saver on(Load detected)
		

Note: The minimum power of a load to take inverter out of sleep mode (Power Saver On) is 25 Watts.

The whole HP Series inverter is designed with extraordinarily low idle power consumption which is 0.8-1.8% of its rated power.

HP Series Idle Power Consumption(in Watts)

Model	Power Saver Off	Power Saver Auto	
	Idle(Max)	3Secs(Max)	Stand-By Mode
1KW	18W	7.5W	2.5W
2KW	30W	10.0W	
3KW	60W	15.0W	
4KW	70W	20.0W	
5KW	80W	25.0W	
6KW	90W	25.0W	
8KW	120W	30.0W	
10KW	150W	35.0W	
12KW	180W	40.0W	

For more detailed technical information, please contact the supplier.

When in the search sense mode, the green power LED will blink and the inverter will make a ticking sound.

At full output voltage, the green power LED will light steadily and the inverter will make a steady humming sound. When the inverter is used as an “uninterruptible” power supply the search sense mode function should be defeated.

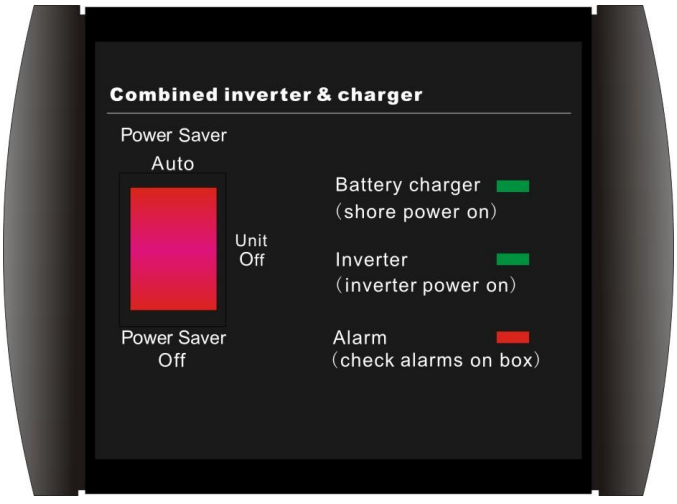
Exceptions
Some devices when scanned by the load sensor cannot be detected. Small fluorescent lights are the most common example. (Try altering the plug polarity by turning the plug over.) Some computers and sophisticated electronics have power supplies that do not present a load until line voltage is available. When this occurs, each unit waits for the other to begin. To drive these loads either a small companion load must be used to bring the inverter out of its search mode, or the inverter may be programmed to remain at full output voltage.

2.5.6 Protections

The HP series inverter is equipped with extensive protections against various harsh situations/faults.
These protections include:
AC Input over voltage protection/AC Input low voltage protection
Low battery alarm/High battery alarm
Over temperature protection/Over load protection
Short Circuit protection (1s after fault)
Back feeding protection

When Over temperature /Over load occur, after the fault is cleared, the master switch has to be reset to restart the inverter.
The Low battery voltage trip point can be customized from defaulted value of 10VDC to 10.5VDC through the SW1 on the DIP switch.
The inverter will go to Over temp protection when the heat sink temp. ≥105 ℃(221℉), and will go to Fault (shutdown Output) after 30 seconds. After temp drops to 90 ℃(194℉), the switch has to be reset to activate the inverter.
The HP series Inverter is with back feeding protection which avoids presenting an AC voltage on the AC input terminal in Invert mode.
After the reason for fault is cleared, the inverter has to be reset to start working.

2.5.7 Remote control



Apart from the switch panel on the front of the inverter, an extra switch panel connected to the RJ11 port at the DC side of the inverter thru a standard telephone cable can also control the operation of the inverter.
If an extra switch panel is connected to the inverter via “remote control port”, together with the panel on the inverter case, the two panels will be connected and operated in parallel.

Whichever first switches from “Off” to “Power saver off” or “Power saver on”, it will power the inverter on.

If the commands from the two panels conflict, the inverter will accept command according to the following priority:

Power saver on> Power saver off> Power off

Only when both panels are turned to “Unit Off” position, the inverter will be powered off.

WARNING

Never cut the telephone cable when the cable is attached to inverter and battery is connected to the inverter. Even the inverter is turned off, this will damage the remote PCB inside if the cable is short circuited during cutting.

2.5.8 LED Indicator & LCD

SHORE POWER ON	GREEN LED lighting on “Line Mode”
INVERTER ON	GREEN LED lighting on “Inv Mode”
FAST CHARGE	Yellow LED lighting on “Fast CHG”
FLOAT CHARGE	GREEN LED lighting on “Float CHG”
OVER TEMP TRIP	RED LED lighting on “Over Temp”
OVER LOAD TRIP	RED LED lighting on “Over Load”
POWER SAVER ON	GREEN LED lighting on “Power Saver on”

Please refer to ‘Indicator and Buzzer’ for the detailed information.

The LCD will display the following content:

Greeting message of “Welcome to ”

AC Status & Input Voltage
"AC: abnormal" is displayed when AC input is not qualified.

Output Voltage/Frequency and Output Current(in percentage) in Inverter mode

Battery voltage

Note:
When the inverter is in Battery Priority mode, "AC:abnormal" will also be displayed when the inverter finishes a complete charging circle and switches to inverter mode.
In AC mode, the LCD will not display the status of AC load.

2.5.9 Audible Alarm

Battery Voltage Low	Inverter green LED Lighting, and the buzzer beep 0.5s every 5s.
Battery Voltage High	Inverter green LED Lighting, and the buzzer beep 0.5s every 1s, and Fault after 60s.
Invert Mode Over-Load	(1)110%<load<125%(±10%), No audible alarm in 14 minutes, Beeps 0.5s every 1s in 15th minute and Fault after 15 minutes; (2)125% <load<150%(±10%), Beeps 0.5s every 1s and Fault after 60s; (3)Load>150%(±10%), Beeps 0.5s every 1s and Fault after 20s;
Over Temperature	Heat sink temp. ≥105ºC(221℉), Over temp red LED Lighting, beeps 0.5s every 1s;

2.5.10 FAN Operation

For 1-3KW, there is one multiple controlled DC fan, for 4-6KW, there is two multiple controlled DC fan which starts to work according to the following logic.
For 8-12KW, there is one multiple controlled DC fan and one AC fan. The DC fan will work in the same way as the one on 1-3KW, while the AC fan will work once there is AC output from the inverter.

So when the inverter is in power saver mode, the AC fan will work from time to time in response to the pulse sent by the inverter in power saver mode.
The Operation of DC fan at the DC terminal side is controlled in the following logic:

Condition	Enter Condition	Leave condition	Speed
HEAT SINK TEMPERATURE	T ≤ 60℃(140℉)	T > 65℃(149℉)	OFF
	65℃(149℉)≤ T < 85 ℃(185℉)	T ≤ 60℃(140℉) or T ≥ 85℃(185℉)	50%
	T > 85℃(185℉)	T ≤ 80℃(176℉)	100%
CHARGER CURRENT	I ≤ 15%	I ≥ 20%	OFF
	20%< I ≤ 50%Max	I≤ 15% or I > 50%Max	50%
	I > 50%Max	I ≤ 40%Max	100%
LOAD Percentage (INV MODE)	Load < 30%	Load ≥ 30%	OFF
	30% ≤ Load < 50%	Load ≤ 20% or Load ≥ 50%	50%
	Load ≥ 50%	Load ≤ 40%	100%

Allow at least 30CM of clearance around the inverter for air flow. Make sure that the air can circulate freely around the unit.
Fan noise level <60db at a distance of 1m

2.5.11 DIP Switches

On the DC end of inverter, there are 5 DIP switches which enable users to customize the performance of the device.

Switch NO	Switch Function	Position: 0	Position: 1
SW1	Low Battery Trip Volt	10.0VDC	10.5VDC
		*2 for 24VDC, *4 for 48VDC	
SW2(230V)	AC Input Range	184-253VAC	154-264VAC(40Hz+)
SW2(120V)	AC Input Range	100-135VAC	90-135VAC(40Hz+)
SW3	Power Saver & Unit Off Charging	Unit Off charging	Power Saver
SW4	Output Frequency	50Hz	60Hz
SW5	Battery/AC Priority	Utility Priority	Battery Priority

Low Battery Trip Volt:
Deep discharge of the lead acid battery leads to high losses in capacity and early aging. In different applications, different low voltage disconnection level is preferred. For example, for solar application, user intended to have less DOD to prolong the battery cycle life. While for mobile application, users intend to have more DOD to reduce battery capacity and on board weight.
For 12VDC model, the Low Battery Trip Volt is set at 10.0VDC by default. It can be customized to 10.5VDC using SW1, this is to prevent batteries from over-discharging while there is only a small load applied on the inverter.
*2 for 24VDC, *4 for 48VDC

AC Input Range:

There are different acceptable AC input ranges for different kinds of loads.
For some relatively sensitive electronic devices, a narrow input range of 184-253VAC (100-135V for 120VAC model) is required to protect them.
While for some resistive loads which work in a wide voltage range, the input AC range can be customized to 154-253VAC (90-135V for 120VAC model), this helps to power loads with the most AC input power without frequent switches to the battery bank.
In order to make the inverter accept dirty power from a generator, when the SW2 is switched to position "1", the inverter will bypass an AC input with a higher voltage(164-264Vac for 230Vac model) and wider frequency (40Hz plus for 50Hz/60Hz). Accordingly, the AC charger will also work in a higher voltage(174-254Vac for 230Vac model) wider freq range (43Hz plus for 50Hz/60Hz).
This will avoid frequent switches between battery and generator. But some sensitive loads will suffer from the low quality power.
The pros and cons should be clearly realized.

Power Saver & Unit Off Charging:
Under the Battery Priority Mode (SW5 in position "1"), the inverter can be switched between two modes: Power Saver Mode (SW3 in position "1") and Unit Off Charging Mode (SW3 in position "0"). The power Switch should be in "Power saver on" position all the time for using these functions.
In Power Saver Mode, the inverter is initially in standby mode and sends a pulse to detect the presence of a load every 3 seconds. Each pulse lasts for 250ms. The inverter will remain in standby mode until a load has been detected. Then it will wake up from standby mode and start to invert electricity from the battery bank to supply the load. As this function is under Battery Priority, the inverter will always prefer to invert electricity from battery first even there is a qualified AC input present.Only when the battery voltage is lower than the low voltage alarm point, will the inverter switch to AC input power to charge the battery and supply the load at the same time.
This Power Saver Mode can be changed to Unit Off Charging mode via SW3 by switching it to "0" position. (SW5 still in "1")
In Unit Off Charging mode, the inverter will stay in standby mode without sensing loads. It won't output any power even if a load is turned on or a qualified AC input is present. The inverter will not perform any function and only stay idle in this mode, unless the battery voltage is low. Then it will start charging the battery. This feature is ideally suitable for applications where energy conservation is required. Charging will only be activated when required.

Output Frequency:
The output frequency of the inverter can be set at either 50Hz or 60Hz by SW4.

AC/Battery Priority:
Our inverter is designed AC priority by default. This means, when AC input is present, the battery will be charged first, and the inverter will transfer the input AC to power the load. Only when the AC input is stable for a continuous period of 15 days will the inverter start a battery inverting cycle to protect the battery. After 1 normal charging cycle ac through put will be restored. For more info, pls refer to our manual at AC Charging Section.
The AC Priority and Battery Priority switch is SW5. When set in battery priority, the inverter will invert from battery despite the AC input. Only when the battery voltage reaches the low voltage alarm point(10.5Vdc for 12Vdc, 21Vdc for 24Vdc, 42Vdc for 48Vdc) will the inverter transfer to AC Input, charge battery, and switch back to battery when the battery is fully charged. This function is mainly for wind/solar systems using utility power as back up.
The AC/Battery Priority function can be activated by sliding the switch even when the inverter is in operation.

Note: In battery priority mode, when qualified AC inputs for the first time and the battery voltage is below 12.5Vdc(12.5Vdc for 12Vdc, 25Vdc for 24Vdc, 51Vdc for 48Vdc), the inverter will go into battery priority mode only after a cycle of bulk charging and absorb charging is finished. The inverter will not go into float charging mode.

2.5.12 Other features

Battery Temperature Sensing

Applying the proper charge voltage is critical for achieving optimum battery performance and longevity. The ideal charge voltage required by batteries changes with battery temperature.

The battery temperature sensor allows the charge controller to continuously adjust charge voltage based on actual battery temperature.

Temperature compensation of charge voltage assures that the battery receives the proper charge voltage as battery temperature varies.

The entire line are equipped with Battery Temperature Sensing for increased charging precision.

It sends precise information to the charger, which automatically adjusts voltage to help ensure full battery charge depending on the ambient temperature of your battery installation.

When the battery voltage is over 40℃(104℉), it will reduce the charging voltage by 0.1Vdc with every degree of temperature rise.

We recommend that you install Battery Temperature Sensors on all banks to protect your batteries and to provide optimal charging of each bank.

The battery temperature sensor mounts on the side of a battery or any other location where the precise temperature of battery can be detected such as battery mounting racks.

The following table describes approximately how much the voltage may vary depending on the temperature of the batteries.

Inverter Condition	Temp on BTS	Operation
Charger Mode	BTS ≥ 50℃(122℉)	Automatically turns off charger
	BTS ≤ 40℃(104℉)	Automatically turns on charger
Inverter Mode	40℃(104℉) ≤ BTS ≤ 50℃(122℉)	Increases the low voltage shut down point by 0.5Vdc
	BTS ≥ 50℃(122℉)	Over Temp Fault

Important: If the battery temperature is allowed to fall to extremely cold temperatures, the inverter with a BTS may not be able to properly recharge cold batteries due to maximum voltage limits of the inverter. Ensure the batteries are protected from extreme temperatures.

Battery voltage recovery start

After low battery voltage shut off(10V for 12V model or 20V for 24V model or 40V for 48V model), the inverter is able to restore to work after the battery voltage recovers to 13V/26V/52V(with power switch still in “On” position). This function helps to save the users extra labor to reactivate the inverter when the low battery voltage returns to acceptable range in renewable energy systems.

WARNING

Never leave the loads unattended, some loads (like a Heater) may cause accidents in such cases.

It is better to shut everything off after low voltage trip than to leave your load in the risk of fire. Nobody

wants to return home, finding house surrounded by fire trucks and naughty neighborhood kids toasting hot dogs against his house.

Auto Gen Start

The inverter can be customized to start up a generator when battery voltage goes low.
When the inverter goes to low battery alarm, it can send a signal to start a generator, and turn the generator off after battery charging is finished.
The auto gen start feature will only work with generators designed to work with this feature. There is an open/close relay that will short circuit the positive and negative cable from a generator. The input DC voltage can vary, but the Max current the relay can carry is 16Amp.

Conformal Coating

The entire line of inverters have been processed with a conformal coating on the PCB, making it water, rust, and dust resistant.
While these units are designed to withstand corrosion from the salty air, they are not splash proof.

3 Installation

3.1 Location

Follow all the local regulations to install the inverter.
Please install the equipment in a location of Dry, Clean, Cool with good ventilation.
Working temperature: －10℃ to 40℃(-14℉to 104℉)
Storage temperature: －40℃ to 70℃(-40℉to 158℉)
Relative Humidity: 0% to 95%，non-condensing
Cooling: Forced air

3.2 DC Wiring Recommendation

It is suggested the battery bank be kept as close as possible to the inverter. The following table is a suggested wiring option for DC cable with length from 1 meter to 5ms.

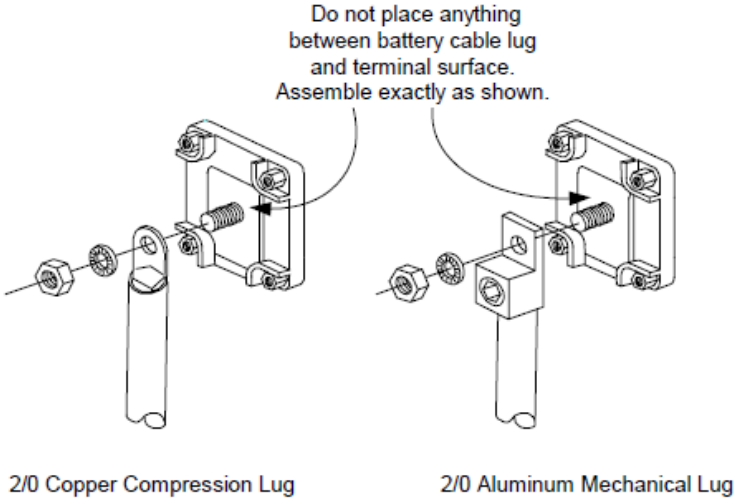
Model Watt	Battery Voltage	Minimun Wire Gage		Model Watt	Battery Voltage	Minimun Wire Gage	
		0~1.0m	1.0~5.0m			0~1.0m	1.0~5.0m
1KW	12 Vdc	30mm²	40mm²	2KW	12 Vdc	60mm²	75mm²
1KW	24 Vdc	15mm²	20mm²	2KW	24 Vdc	30mm²	45mm²
1KW	48 Vdc	10mm²	15mm²	2KW	48 Vdc	15mm²	25mm²
3KW	12 Vdc	90mm²	120mm²	4KW	12 Vdc	120mm²	150mm²
3KW	24 Vdc	45mm²	60mm²	4KW	24 Vdc	60mm²	75mm²
3KW	48 Vdc	25mm²	30mm²	4KW	48 Vdc	30mm²	40mm²
5KW	24 Vdc	75mm²	95mm²	6KW	24 Vdc	90mm²	120mm²
5KW	48 Vdc	40mm²	50mm²	6KW	48 Vdc	45mm²	60mm²
8KW	24 Vdc	120mm²	150mm²	8KW	48 Vdc	75mm²	95mm²
8KW	48 Vdc	60mm²	75mm²	12KW	48 Vdc	90mm²	120mm²

Please follow the above minimum wire size requirement.

One cable is always best, but if there is a problem obtaining for example 100mm ²cable, use 2*50mm ²or 3*35mm ²instead, as long as the square area adds up. Performance of any product can be improved by thicker cable and shorter runs, so if in doubt round up and keep the length as short as possible.

Battery cables must have crimped (or preferably, soldered and crimped) copper compression lugs unless aluminum mechanical lugs are used. Soldered connections alone are not acceptable. High quality, UL-listed battery cables are available .These cables are color-coded with pressure crimped, sealed ring terminals.

Battery terminal must be clean to reduce the resistance between the DC terminal and cable connection. A buildup of dirt or oxidation may eventually lead to the cable terminal overheating during periods of high current draw. Use a stiff wire brush and remove all dirt and corrosion from the battery terminals and cables.



Reducing RF interference

To reduce the effect of radiated interference, twist the DC cables. To further reduce RF interference, shield the cables with sheathing /copper foil / braiding.

Taping battery cables together to reduce inductance

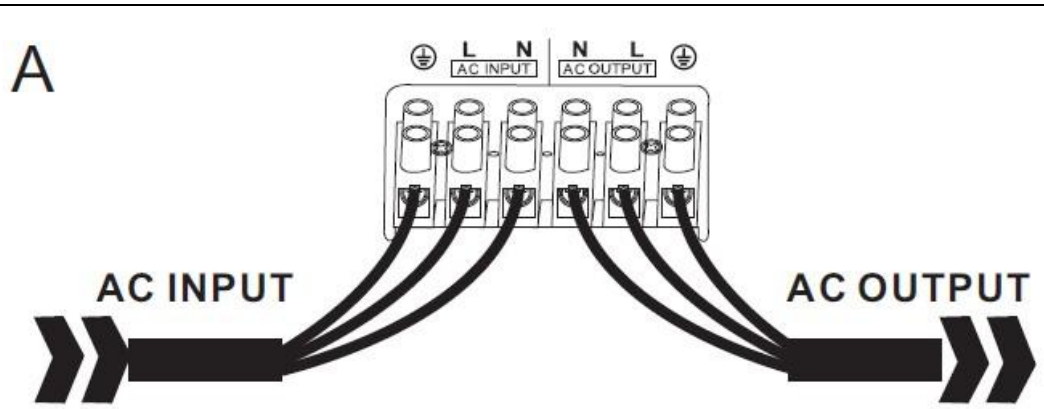
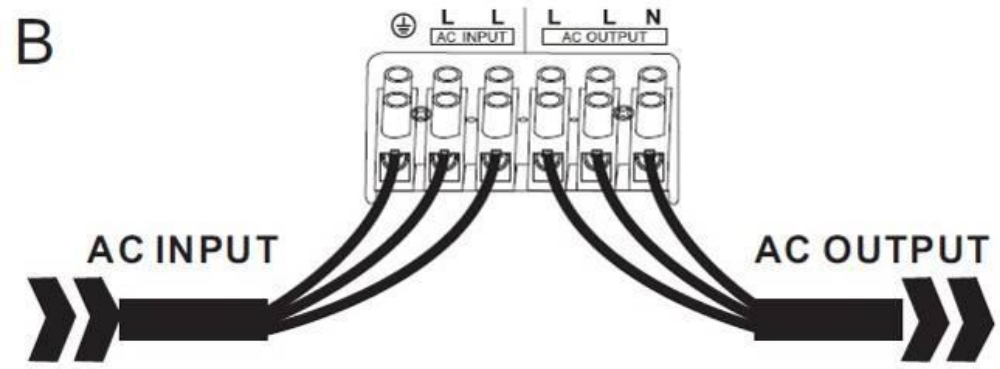
Do not keep the battery cables far apart. In case it is not convenient to twist the cables, keep them taped together to reduce their inductance. Reduced inductance of the battery cables helps to reduce induced voltages. This reduces ripple in the battery cables and improves performance and efficiency.

WARNING	The torque rating range for DC terminal is 12.5NM-20.5NM(9.25-15.19 pound-foot), and the suggested torque rating is 17NM(12.6 pound-foot). Over torquing may cause the bolt to break.
	Equipment Damage The inverter is not reverse polarity protected. Reversing the battery polarity on the DC input connections will cause permanent damage to the inverter which is not covered under warranty. Always check polarity before making connections to the inverter.
	The inverter contains capacitors that may produce a spark when first connected to battery. Do not mount in a confined a battery or gas compartment.
	Ensure the inverter is off before disconnecting the battery cables, and that AC power is disconnected from the inverter input.

3.3 AC Wiring Recommendation

We recommend using 10 to 5Awg wire to connect to the ac terminal block.
When in AC mode the AC input power will supply both the loads and AC charger, a thicker wire gauge for AC Input is required. Pls consult a qualified electrician about the specific wire gauge required in terms of wire material and inverter power.

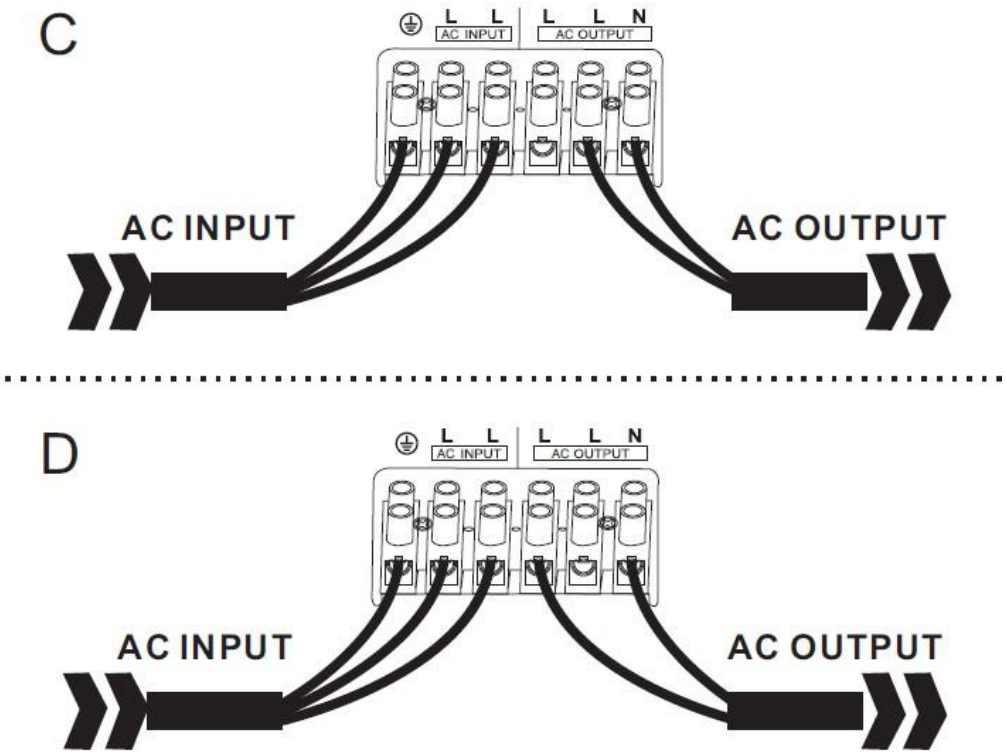
There are 3 different ways of connecting to the terminal block depending on the model. All the wirings are CE compliant, Call our tech support if you are not sure about how to wire any part of your inverter.

Wiring Option 1 230V single phase/120V single phase Input: Hot line+Neutral+Ground Output: Hot line+Neutral+Ground	
Wiring Option 2 230V split phase Input: Hot line+ Hot line +Ground Output: Hot line+ Hot line +Neutral	

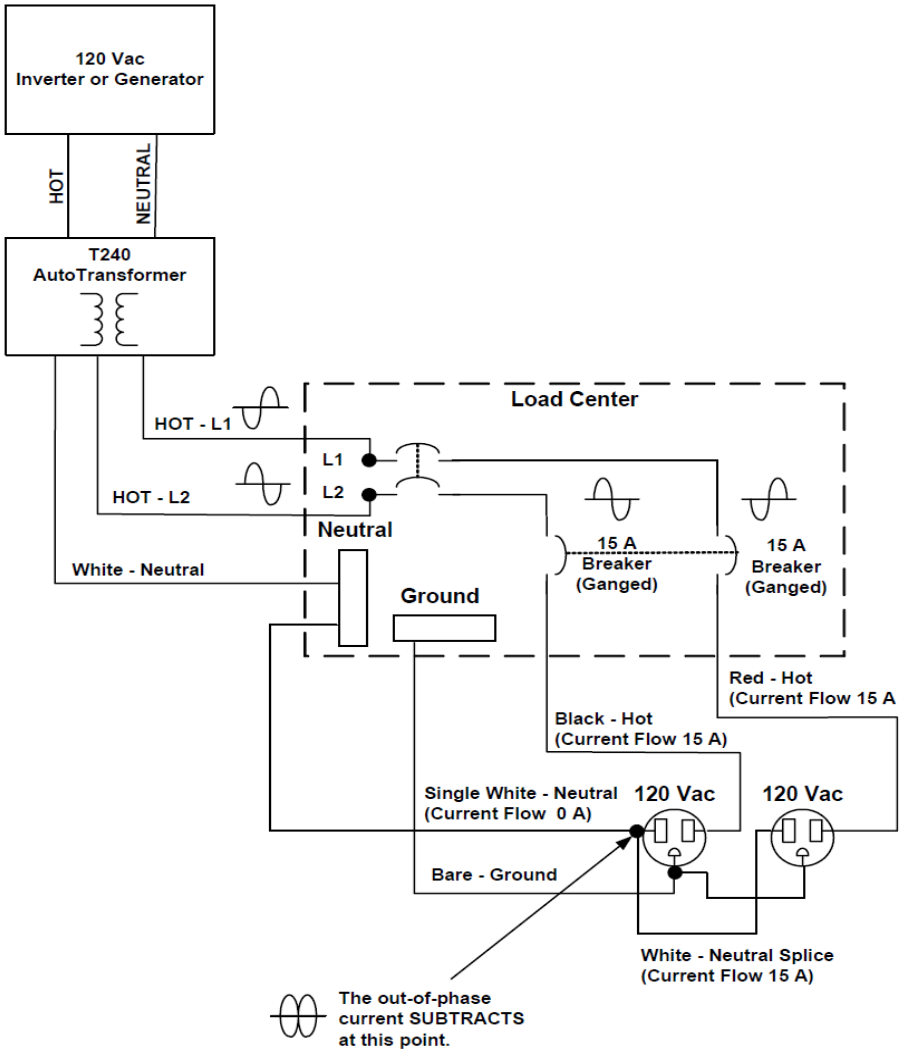
Wiring Option 3

230V split phase
Input: Hot line+ Hot line +Ground
Output: Hot line +Neutral

Remark: In such cases, each output hotline can only carry a max of half the rated capacity.



Caution:
Wiring Option 2 and Wiring Option 3 are only allowed for split phase models.
Pls wire all the other models according to Wiring Option 1.



 **WARNING**

For split phase models, AC input neutral is not required in wiring. Never Connect Input Neutral to Output Neutral. Damage will result which is not covered under warranty.

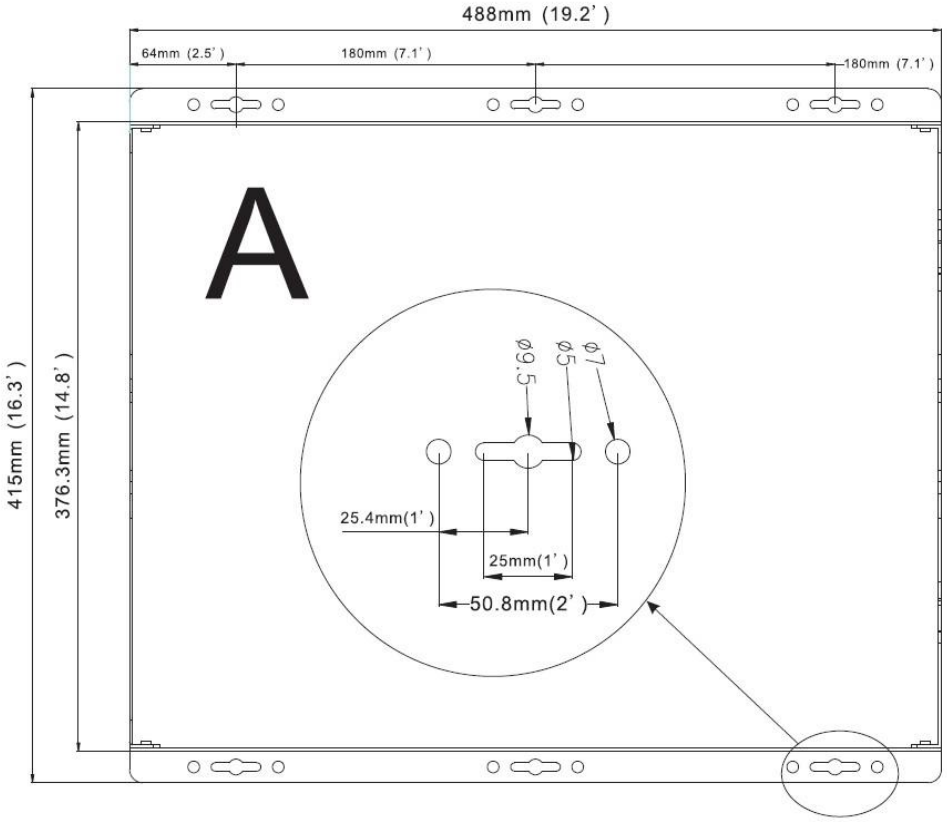
 **WARNING**

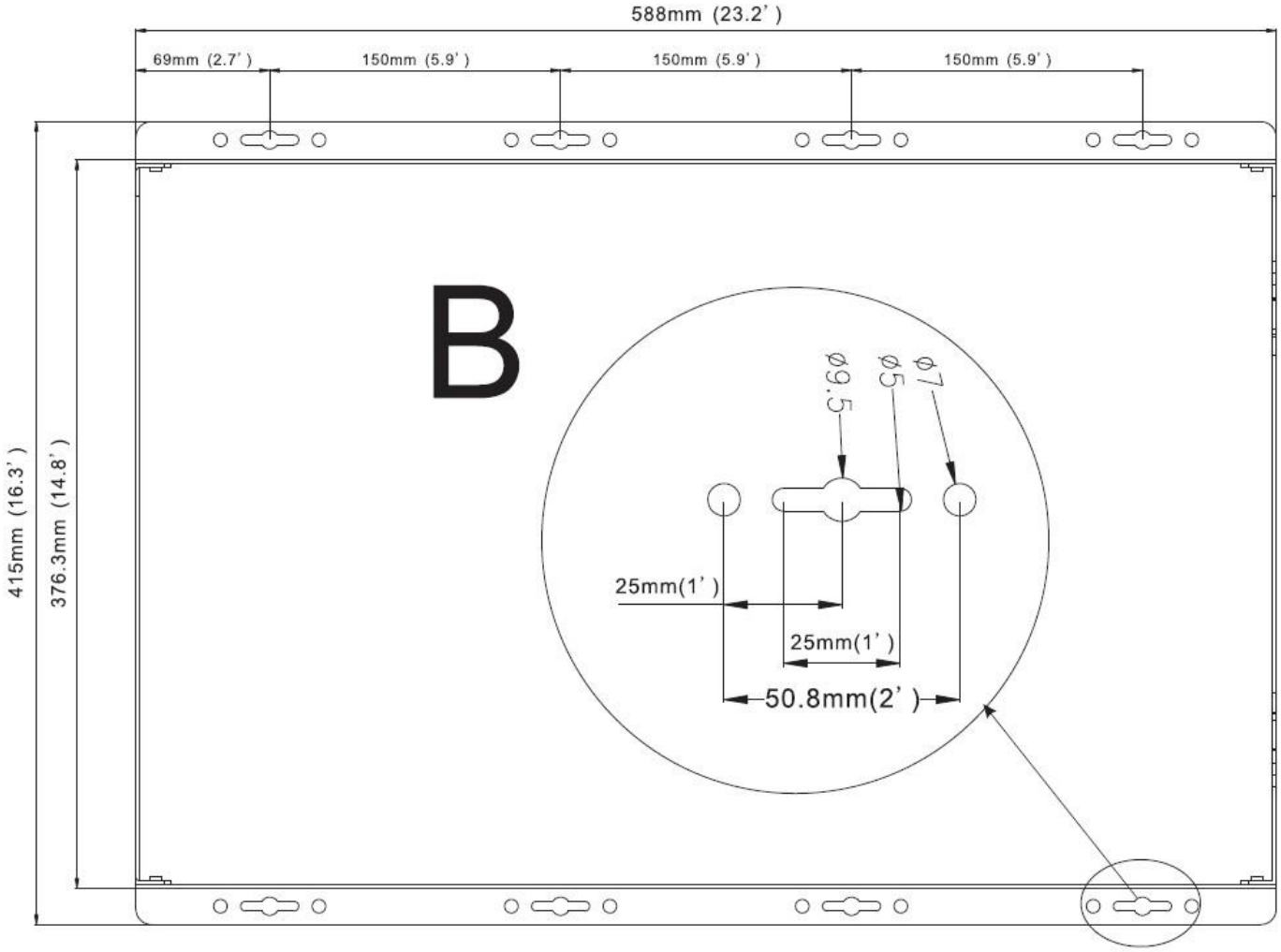
The output voltage of this unit must never be connected in its input AC terminal, overload or damage may result.
Always switch on the inverter before plugging in any appliance.

3.4 Grounding

Connect an AWG 8 gauge or greater copper wire between the grounding terminal on the inverter and the earth grounding system or the vehicle chassis.

3.5 Install Flange





4 Troubleshooting Guide

Troubleshooting contains information about how to troubleshoot possible error conditions while using the HP Inverter & Charger.

The following chart is designed to help you quickly pinpoint the most common inverter failures.

Indicator and Buzzer

		Indicator on top cover							LED on Remote Switch			
Status	**Item**	SHORE POWER ON	INVERTER ON	FAST CHG	FLOAT CHG	OVER TEMP TRIP	OVER LOAD TRIP	POWER SAVER ON	BATT CHG	INVERTER	Alarm	Buzzer
Line Mode	CC	√	×	√	×	×	×	×	√	×	×	×
	CV	√	×	√, blink	×	×	×	×	√	×	×	×
	Float	√	×	×	√	×	×	×	√	×	×	×
	Standby	√	×	×	×	×	×	×	×	×	×	×
Inverter Mode	Inverter On	×	√	×	×	×	×	×	×	√	×	×
	Power Saver	×	×	×	×	×	×	√	×	×	×	×
Inverter Mode	Battery Low	×	√	×	×	×	×	×	×	√	√	Beep 0.5s every 5s
	Battery High	×	√	×	×	×	×	×	×	√	√	Beep 0.5s every 1s
	Overload On Invert Mode	×	√	×	×	×	√	×	×	√	√	Refer to “Audible alarm”
	Over-Temp On Invert Mode	×	√	×	×	√	×	×	×	√	√	Beep 0.5s every 1s
	Over-Temp On Line Mode	√	×	√	×	√	×	×	√	×	√	Beep 0.5s every 1s
	Over Charge	√	×	√	×	×	×	×	√	×	√	Beep 0.5s every 1s
Fault Mode	Fan Lock	×	×	×	×	×	×	×	×	×	×	Beep continuous
	Battery High	×	√	×	×	×	×	×	×	√	×	Beep continuous
	Inverter Mode Overload	×	×	×	×	×	√	×	×	×	×	Beep continuous
	Output Short	×	×	×	×	×	√	×	×	×	√	Beep continuous
	Over-Temp	×	×	×	×	√	×	×	×	×	×	Beep continuous
	Over Charge	×	×	√	×	×	×	×	√	×	×	Beep continuous

	Back Feed Short	×	×	×	×	×	×	×	×	×	×	Beep continuous

Symptom	Possible Cause	Recommended Solution
Inverter will not turn on during initial power up.	Batteries are not connected, loose battery-side connections. Low battery voltage.	Check the batteries and cable connections. Check DC fuse and breaker. Charge the battery.
No AC output voltage and no indicator lights ON.	Inverter has been manually transitioned to OFF mode.	Press the switch to Power saver on or Power saver off position.
AC output voltage is low and the inverter turns loads OFF in a short time.	Low battery.	Check the condition of the batteries and recharge if possible.
Charger is inoperative and unit will not accept AC.	AC voltage has dropped out-of-tolerance	Check the AC voltage for proper voltage and frequency.
Charger is supplying a lower charge rate.	Charger controls are improperly set. Low AC input voltage. Loose battery or AC input connections.	Refer to the section on adjusting the "Charger Rate". Source qualified AC power.. Check all DC /AC connections.
Charger turns OFF while charging from a generator.	High AC input voltages from the generator.	Load the generator down with a heavy load. Turn the generator output voltage down.
Sensitive loads turn off temporarily when transferring between grid and inverting.	Inverter's Low voltage trip voltage may be too low to sustain certain loads.	Choose narrow AC voltage in the DIP switch, or Install a UPS if possible.
Noise from Transformer/case*	Applying specific loads such as hair drier	Remove the loads

***The reason for the noise from transformer and/or case**

When in inverter mode and the transformer and/or case of the inverter sometimes may vibrate and make noise.

The noise may come from transformer.

According to the characteristics of our inverter, there is one type of load which will most likely to cause rattles of transformer, that is a half-wave load, load that uses only a half cycle of the power(see figure 1). This trends to cause imbalance of magnetic field of transformer, reducing its rated working freq from 20KHz to, say, maybe 15KHz (it varies according to different loads). This way, the freq of noise falls exactly into the range (200Hz-20KHz) that human ear can sense.

The most common load of such kind is hair drier.

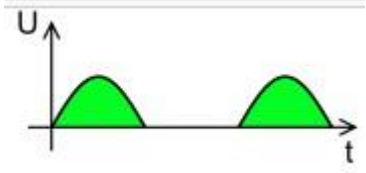


Figure 1
Half Cycle Load Waveform

If the noise comes from case.

Normally when loaded with inductive loads, the magnetic field generated by transformer keeps attracting or releasing the steel case at a specific freq, this may also cause noise.
This noise may also be generated the moment a load is detected in the power saver mode.
Reducing the load power or using an inverter with bigger capacity will normally solve this problem.
The noise willn't do any harm to the inverter or the loads.

5 Warranty

We offer 1 year limited warranty.
But the following cases are not covered under warranty.

1 DC polarity reverse.
The inverter is designed without DC polarity reverse protection. A polarity reverse may severely damage the inverter.

2 Wrong AC wiring

3 Operation in a condensing environment.

4 Operation with an undersized generator or generator with unqualified wave form.
To guarantee the best performance of inverter, the standby generator should be at least of 150%higher capacity than the inverter.

6 Model Numbering

The HP Inverter is identified by the model/serial number labels. Model Number label is located on the side of the cover. All the necessary information is provided on the label such as battery voltage, AC output voltage, power and frequency.
For example

Model Number	Power	Battery voltage	AC voltage	Phase
HP1012120	1000W	12Vdc	120Vac	Single phase
HP2012230	2000W	12Vdc	230Vac	Single phase
HP12048120230	12000W	48Vdc	120/230Vac	Split phase

Appendix 1

HP Series Inverter & Charger Spec Sheet

Electrical Specifications

	Model	HP 1KW	HP 1.5KW	HP 2KW	HP 3KW	HP 4KW	HP 5KW	HP 6KW	HP 8KW	HP 10KW	HP 12KW
Inverter Output	Continuous Output Power	1000W	1500W	2000W	3000W	4000W	5000W	6000W	8000W	10000W	12000W
	Surge Rating(20s)	3000W	4500W	6000W	9000W	12000W	15000W	18000W	24000W	30000W	36000W
	Capable of Starting Electric Motor	1HP	1.5HP	2HP	3HP	4HP	5HP	6HP	8HP	10HP	12HP
	Output Waveform	Pure Sine wave/Same as input(Bypass mode)									
	Nominal Efficiency	>88%(Peak)									
	Line Mode Efficiency	>95%									
	Power Factor	0.9-1.0									
	Nominal Output Voltage RMS	100-110-120Vac / 220-230-240Vac									
	Output Voltage Regulation	±10% RMS									
	Output Frequency	50/60Hz ±0.3Hz									
	Short Circuit Protection	Yes, Current Limit Function (Fault after 1sec)									
	Typical transfer Time	10ms(Max)									
	THD	Typically <7%, Max 10% under full linear load									
DC Input	Nominal Input Voltage	12.0Vdc(*2 for 24Vdc, *4 for 48Vdc)									
	Minimum Start Voltage	10.0Vdc									
	Low Battery Alarm	10.5Vdc / 11.0Vdc									
	Low Battery Trip	10.0Vdc / 10.5Vdc									
	High Voltage Alarm & Fault	16.0Vdc									
	High DC Input Recovery	15.5Vdc									
	Low Battery Voltage Recover	13.0Vdc									
	Idle Consumption-Search Mode	< 25 W when Power Saver On									
Charge	Input Voltage Range	Narrow: 100~135VAC / 194~243VAC; Wide: 90~135VAC / 164~243VAC;									
	Input Frequency Range	Narrow: 47-55±0.3Hz for 50Hz, 57-65±0.3Hz for 60Hz Wide:43±0.3Hz plus for 50Hz/60Hz									
	Output Voltage	Depends on battery type									
	Charger Breaker Rating(230Vac)	10A	10A	10A	20A	20A	30A	30A	40A	40A	40A
	Charger Breaker Rating(120Vac)	10A	20A	20A	30A	40A	63A	63A			
	Max Charge Rate	15A to 120A +/-5A , depending on models									

	Over Charge Protection Shutdown	15.7V for 12Vdc (*2 for 24Vdc, *4 for 48Vdc)									
	Battery type	Fast Vdc				Float Vdc					
	Gel U.S.A	14.0				13.7					
	A.G.M 1	14.1				13.4					
	A.G.M 2	14.6				13.7					
	Sealed Lead Acid	14.4				13.6					
	Gel Euro	14.4				13.8					
	Open Lead Acid	14.8				13.3					
	Calcium	15.1				13.6					
	De-sulphation	15.5 for 4hrs									
	Remote Control	Yes. Optional									
Bypass & Protection	Input Voltage Waveform	Sine wave (Grid or Generator)									
	Nominal Voltage	120Vac				230Vac					
	Low Voltage Trip	80V/90V ±4%				184V/154V ±4%					
	Low Voltage re engage	90V/100V ±4%				194V/164V ±4%					
	High Voltage Trip	140V ±4%				253V ±4%					
	High Voltage re engage	135V ±4%				243V ±4%					
	Max Input AC Voltage	150VAC				270VAC					
	Nominal Input Frequency	50Hz or 60Hz (Auto detect)									
	Low Freq Trip	Narrow: 47 ±0.3Hz for 50Hz, 57 ±0.3Hz for 60Hz Wide:40 ±0.3Hz for 50Hz/60Hz									
	Low Freq re engage	Narrow: 48 ±0.3Hz for 50Hz, 58 ±0.3Hz for 60Hz Wide:45 ±0.3Hz for 50Hz/60Hz									
	High Freq Trip	Narrow: 55 ±0.3Hz for 50Hz, 65 ±0.3Hz for 60Hz Wide: No up limit for 50Hz/60Hz									
	High Freq re engage	Narrow: 54 ±0.3Hz for 50Hz, 64 ±0.3Hz for 60Hz Wide: No up limit for 50Hz/60Hz									
	Output Short circuit protection	Circuit breaker									
	Bypass breaker rating(230Vac)	10A	15A	20A	30A	30A	40A	40A	50A	63A	63A
	Bypass breaker rating(120Vac)	20A	20A	30A	40A	50A	80A	80A			
Mechanical Specification	Mounting	Wall mount									
	Inverter Dimensions(L*W*H)	388*415*200mm				488*415*200mm			588*415*200mm		
	Inverter Weight	16KG	17KG	20KG	24KG	35KG	45KG	45KG	60KG	66KG	70KG
	Shipping Dimensions(L*W*H)	550*520*310mm				650*520*310mm			760*540*410mm		
	Shipping Weight	18KG	19KG	22KG	26KG	37KG	47KG	47KG	58KG	79KG	82KG
	Display	Status LEDs+LCD									
	Standard Warranty	1 Year									

※Errors and omissions reserved. Specifications in this manual are subject to change without prior notice.